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(56) Documents cited
GB 2216240 A GB 2193561 A GB 2080926 A
US 4756492 A US 4572463 A US 3842741 A

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INT CL[5] F42B 12/04 12/06 12/08 12/16
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(54) **Telescopic penetrator**

(57) A telescopically extendable long rod kinetic energy penetrator comprising a first penetrator element (5) having a sleeve region (6) and a second penetrator element (7) having a core region (8) axially slideable within the sleeve region (6) of the first penetrator element (5) the relative lengths of the core and sleeve regions being such that the penetrator is telescopically deployable from a retracted configuration in which the length of the first and second penetrator element combination is L to an extended configuration in which the length of the first and second penetrator combination is at least 4L/3, the average mass per unit length of the sleeve region (6) being from 50% to 300% of the average mass per unit length of the core region (8).

The penetrator may be explosively or aerodynamically extended; and may contain energy absorbing means (34) for reducing the load on the second element (7) as the penetrator is accelerated.

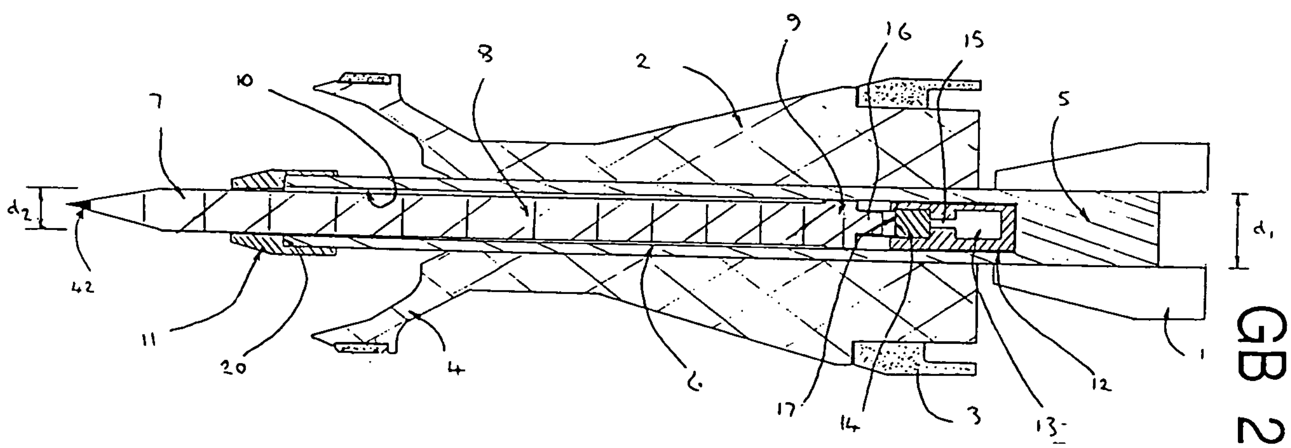

FIG. 1

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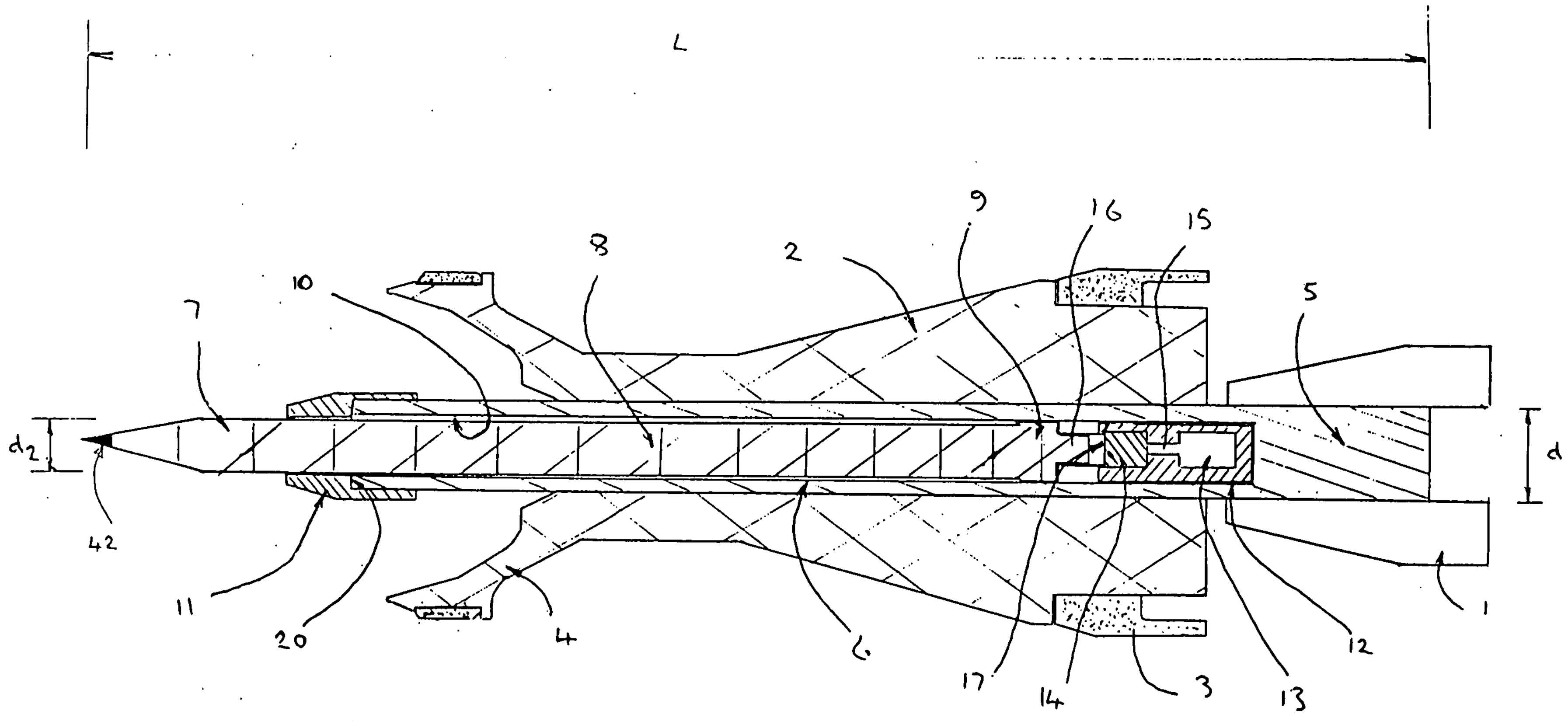
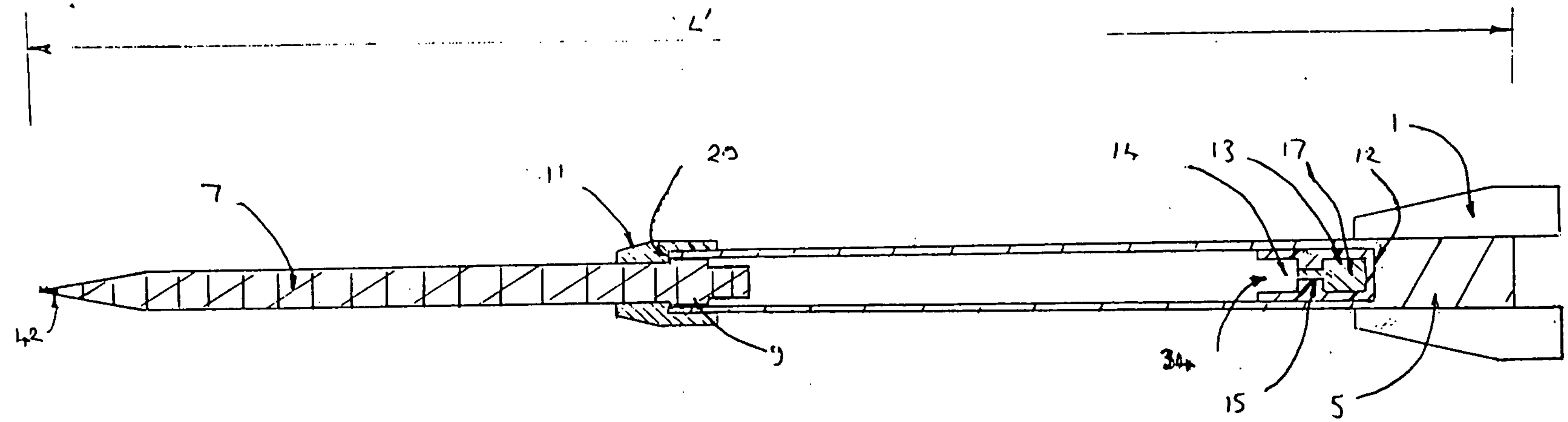
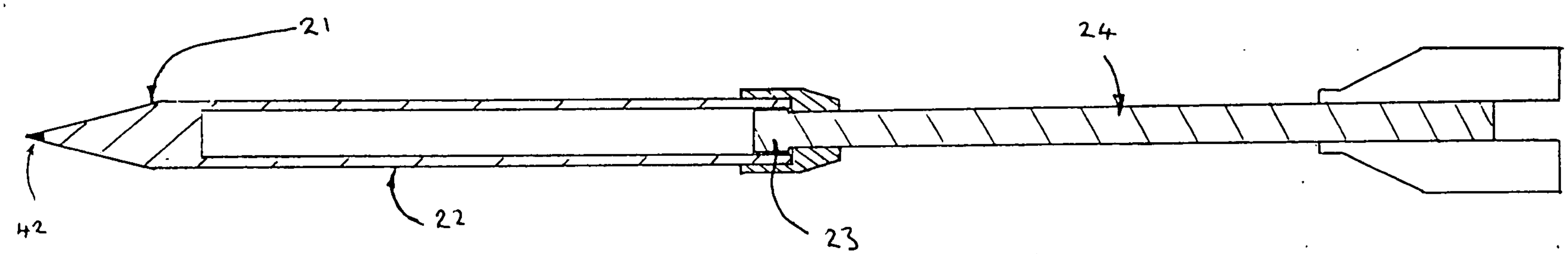


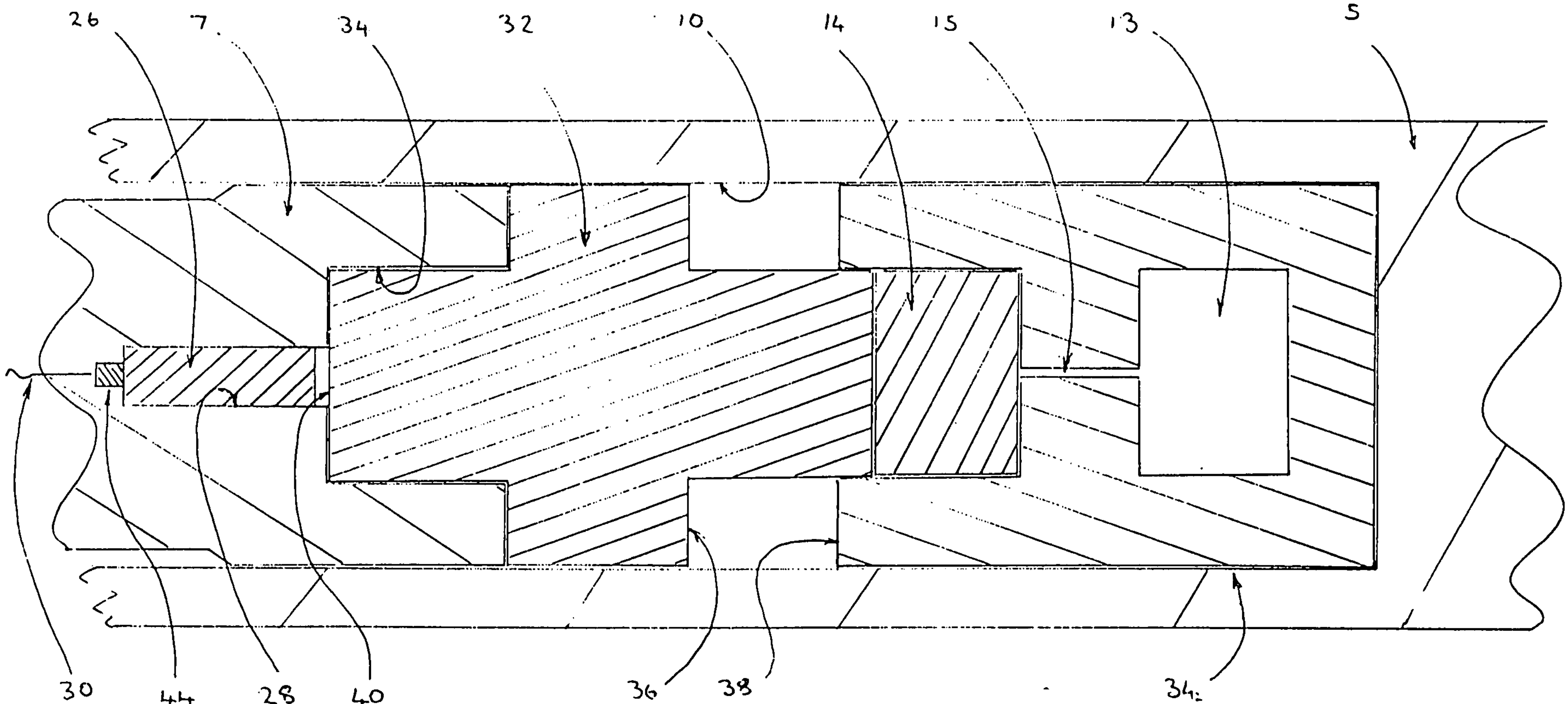
F I G. 1



F I G. 2



F I G. 3



F I G. 4

Kinetic Energy Penetrator

The present invention relates to the field of long rod kinetic energy penetrators used for penetrating armour.

The effectiveness of a monolithic kinetic energy penetrator in defeating armour is related to its length to diameter ratio referred to as aspect ratio. Generally speaking for a penetrator of a given mass its penetrative ability is higher if it has a higher aspect ratio. There are however a number of problems associated with penetrators having a very high aspect ratio including storage and handling problems, compressive failure, tensile failure and buckling failure of the penetrator during launch, aerodynamic stability in flight and yaw resulting in the penetrator striking the target at a high obliquity.

In the past a number of modifications to conventional kinetic energy penetrators have been proposed in order to enhance their performance, most of these modifications have been aimed at increasing the penetrator's performance against spaced or reactive armour. GB Patents 2110799 and 2193561 and US Patent 4597333 propose the use of a small pre-penetrator which is launched with, but arrives at the target before, the main penetrator. In GB 2110799 and US 4597333 the pre-penetrator separates from the main penetrator before it arrives at the target, and for this reason has to be stable in flight. In GB 2193561 the small pre-penetrator is housed in a cylindrical casing in front of the main penetrator and is explosively deployed into a set forward position. In all of these proposals small pre-penetrators are provided to effect the initial interaction of the main penetrator with the target. However, they all suffer from the disadvantage that the penetrative capability of the main penetrator is not increased.

The inventors have surprisingly found that if the mass of a penetrator is distributed as a telescope having an inner core followed by or following a larger diameter hollow sleeve a

significant increase in penetrative capability can be achieved (30%) relative to a penetrator having the same mass and a launch length comparable with the length of the telescopically contracted penetrator.

Thus according to the invention there is provided a telescopically extendable long rod kinetic energy penetrator comprising a first penetrator element having a sleeve region and a second penetrator element having a core region axially slideable within the sleeve region of the first penetrator element the relative lengths of the core and sleeve regions being such that the penetrator is telescopically deployable from a retracted configuration in which the length of the first and second penetrator element combination is L to an extended configuration in which the unbroken length of the first and second penetrator element combination is at least 4L/3, the average mass per unit length of the sleeve region being from 50% to 300% (preferably 75% to 200%) of the average mass per unit length of the core region.

By launching the penetrator in the retracted configuration and deploying it into the extended configuration before it arrives at a target the enhanced penetrative qualities of a high aspect ratio penetrator can be obtained while avoiding at least some of the problems normally associated with such a penetrator.

In order that the penetrator has a high distributed mass as well as a high aspect ratio, each penetrator elements preferably has a density greater than 12000 Kg/m^3 and the density of any one element is preferably within 25% of the density of any other element. Suitable materials for the penetrator elements include uranium, tungsten and alloys of these metals.

In the extended configuration the unbroken length of the first and second penetrator combination is preferably at least 3L/2.

To increase the maximum attainable extended length one or more telescopic elements may be positioned between the first and second penetrator elements.

When the penetrator is extended its foremost element preferably has a diameter of at least 0.5d, where d is the maximum diameter of any penetrator element, so that all parts of the penetrator may pass in an undisturbed manner into a crater made by the foremost penetrator element.

The elements are preferably prevented from complete separation by stop means which conveniently comprises a collar connected to an end of the first penetrator element.

In order to reduce the stresses on the penetrator elements during launch, energy absorbing means is preferably provided for controlling the retraction of one penetrator element relative to another. This energy absorbing means conveniently comprises two chambers one of which contains a body of viscous material such as lead connected by an orifice arranged such that the viscous material flows through the orifice during penetrator launch.

The penetrator preferably comprises means for extending it in flight, which means conveniently comprises a tail unit which acts to extend the penetrator by aerodynamic drag acting on the rearwardly deployable element. The extending means may alternatively conveniently comprises a gas generating charge, preferably an explosive charge, the initiation of which is effected by a proximity sensor linked to an initiator.

When energy absorbing means are provided for controlling the retraction of one penetrator element relative to another and telescopic extension is effected by a gas generating charge a piston is preferably provided which is slidingly positioned in the sleeve region of the first penetrator element between the second

penetrator element and the energy absorbing means. The function of such a piston is to engage a stop prior to initiation of the charge in order that thrust from the charge is not absorbed by the energy absorbing means.

The initiatior may alternatively be connected to a sensor adapted to receive a signal from a remote location.

The invention will now be described by way of example only with reference to the following figures in which:-

Figure 1 is of a two part telescopic penetrator according to the invention with an associated sabot ready for launching;

Figure 2 is of the penetrator of Figure 1 in its extended configuration;

Figure 3 is of an alternative embodiment of the invention in its extended configuration;

Figure 4 is a cross section of the rear part of a telescopic penetrator according to the invention with an explosive charge for extending the penetrator.

The penetrator and sabot shown in Figure 1 incorporates a number of elements which are well known in the long rod penetrator art, and will not be described in detail. These elements include: tail fins 1 which are connected to the rearmost penetrator section, sabot 2 which surrounds the penetrator during launch but is aerodynamically stripped from the penetrator shortly after muzzle exit, obturating seal 3 which acts to prevent propelling gas leaking between the sabot and gun barrel during launch, and an air scoop bore rider 4 which is a forward extension of the sabot and acts to support the front end of the rod during launch and aerodynamically strip the sabot from the penetrator in flight.

The penetrator comprises a first penetrator element 5 having external diameter d_1 and a sleeve region 6. Telescoped inside the first penetrator element is a second penetrator element 7 having external diameter d_2 ($=0.6d_1$), and core region 8. Both of the penetrator elements are preferably made of the same high density metal alloy or metal such as tungsten or depleted uranium. At the rear end of the second penetrator a raised land 9 is provided which acts to support the second penetrator element in a bore 10 in the first penetrator element. A collar 11 is screwed to the forward end of the first penetrator element and acts to slideably support the second penetrator element. An energy absorbing device 12 is positioned at the rear end of bore 10, which comprises rear chamber 13 and front chamber 14 connected by a channel 15. The front chamber 14 is filled with a viscous material such as lead, and is dimensioned to receive a rear extension 16 of the second penetrator element.

The overall length of the first and second penetrator element combination in the retracted configuration shown in Figure 1 is L.

The deployment of the penetrator will now be described with reference to Figures 1 and 2.

As the penetrator is accelerated in a gun barrel by the sabot 2 the second penetrator element 7 sets back slightly relative to the first penetrator element 5. This relative movement is accompanied in the energy absorbing device 34 by the movement of the viscous material 17 from front chamber 14 to rear chamber 13 through passage 15, as shown in Figure 2. This energy absorbing operation prevents the second penetrator section from failing as a result of the high acceleration force being imparted to it over its relatively small cross sectional area. Shortly after the sabot and penetrator leave the gun barrel the sabot is aerodynamically stripped from the penetrator. Close to the target a proximity sensor 42 actuates a release mechanism and allows the high aerodynamic drag on the tail

fins 1 to retard the outer penetrator element relative to the inner penetrator element and extend the penetrator to the configuration shown in Figure 2. Complete separation of the penetrator elements is prevented by the engagement of the raised land 9 on the second penetrator element 7 with a rearwardly facing stop face 20 on collar 11. The increase in first and second penetrator element combination to L' increases the penetrator's aspect ratio and considerably increases its penetrative capabilities.

In order to increase the penetrator's stability in flight it may be deployed into the extended configuration shown in Figure 4 close to the target by an explosive charge 26 which is located in a bore 28 in that rear end of the second penetrator element 7. The explosive charge 26 is initiated by a detonator 44 which is actuated by a proximity sensor 42 located at the front end of the second penetrator element 7. The proximity sensor is connected to the detonator 44 by a wire 30.

In order to provide a non deformable surface against which pressure from the explosive charge 26 may react when detonated a sliding piston 32 is provided which slidingly engages the bore 10. A front end of the piston 32 engages a recess 34 in the rear end of the second penetrator element 7. A rear end of the piston 32 is slideable in the front chamber 14 of the energy absorbing device 34. Rearward movement of the second penetrator element 7 and the piston 32 relative to the energy absorbing device 34 and first penetrator element 5 is limited by abutment of a first rearwardly facing annular surface 36 on the piston against a second annular surface 38 on the front of the energy absorbing device 34. The projectile is designed so that this abutment has occurred by the time the charge 26 is detonated. Pressure from the charge 26 then acts on a front face 40 of the piston and drives the second penetrator element 7 away from the piston 32 along the bore 10 in the first penetrator element 5, thus telescopically extending the penetrator.

Figure 3 shows a second embodiment of the invention in which the foremost penetrator element 21 has a tubular region 22, and the rearmost penetrator element 23 has a core region 24 and tail fins 25. The methods of deploying this penetrator into its extended configuration are the same as those described above for the embodiment shown in Figures 1 and 2, except that the core region 24 moves rearwardly rather than forwardly with respect to the tubular region under the action of the drag produced by the tail fins.

CLAIMS

UK

1 A telescopically extendable long rod kinetic energy penetrator comprising a first penetrator element having a sleeve region and a second penetrator element having a core region axially slideable within the sleeve region of the first penetrator element the relative lengths of the core and sleeve regions being such that the penetrator is telescopically deployable from a retracted configuration in which the length of the first and second penetrator element combination is L to an extended configuration in which the unbroken length of the first and second penetrator element combination is at least 4L/3, the average mass per unit length of the sleeve region being from 50% to 300% of the average mass per unit length of the core region.

2 A telescopically extendable penetrator as claimed in claim 1 wherein the density of the first penetrator element material is within 25% of the density of the second penetrator element material.

3 A telescopically extendable penetrator as claimed in claim 1 or claim 2 wherein the density of each penetrator element is greater than 12000 Kg/m^3.

4 A telescopically extendable penetrator as claimed in any preceding claim wherein each penetrator elements is made of a material selected from uranium, tungsten or an alloy of uranium or tungsten.

5 A telescopically extendable penetrator as claimed in any preceding claim wherein in its extended configuration the length of the first and second penetrator element combination is at least 3L/2.

6 A telescopically extendable penetrator as claimed in any preceding claim wherein one or more tubular penetrator elements are interposed between the first and second penetrator elements.

7 A telescopically extendable penetrator as claimed in any preceding claim wherein the diameter of the foremost section of the penetrator when extended is at least 0.5d where d is the maximum diameter of any penetrator element.

8 A telescopically extendable penetrator as claimed in any preceding claim wherein retaining means is provided to prevent complete separation of the penetrator elements at the end of telescopic deployment.

9 A telescopically extendable penetrator as claimed in claim 8 wherein the retaining means is a collar connected to an end of the first penetrator element.

10 A telescopically extendable penetrator as claimed in any preceding claim further comprising energy absorbing means located between the first and second penetrator elements for controlling retraction of the penetrator elements during launch.

11 A telescopically extendable penetrator as claimed in claim 10 wherein the energy absorbing means comprises a body of viscous material.

12 A telescopically extendable penetrator as claimed in claim 11 wherein the body of viscous material comprises a body of lead which is mounted to absorb energy by means of deformation.

13 A telescopically extendable penetrator as claimed in claim 11 or claim 12 wherein energy absorbing means further comprises two chambers one of which contains the body of viscous material connected by an orifice arranged such that the viscous material flows through the orifice during penetrator launch.

14 A telescopically extendable penetrator as claimed in claim 13 wherein a piston is slidingly positioned in the sleeve region of the first penetrator element between the second penetrator element and the energy absorbing means.

15 A telescopically extendable penetrator as claimed in any preceding claim further comprising extension means for extending the penetrator in flight.

16 A telescopically extendable penetrator as claimed in claim 15 wherein the extension means comprises a tail unit which act to extend the projectile by aerodynamic drag acting on the rearwardly deployable element.

17 A telescopically extendable penetrator as claimed in claim 15 wherein the extension means comprises a gas generating charge and an initiator.

18 A telescopically extendable penetrator as claimed in claim 17 wherein the penetrator further comprises a proximity sensor connected to the initiator for initiating the charge when the projectile approaches a target.

19 A telescopically extendable penetrator as claimed in any preceding claim wherein an extension prevention means is provided which is deactivated upon receiving a signal from a proximity sensor.

20 A telescopically extendable penetrator substantially as herein before described with reference to Figures 1, 2 and 4 or Figure 3.

Patents Act 1977
[illegible]iner's report to the Comptroller under Section 17 (The Search Report)

Application number

9024405

Relevant Technical fields

(i) UK Cl (Edition K) F3A

(ii) Int Cl (Edition 5) F42B 12/04, 12/06, 12/08, 12/16

Search Examiner

J S BOOTH

Databases (see over)

(i) UK Patent Office

(ii) ONLINE: WPI

Date of Search

8 FEBRUARY 1991

Documents considered relevant following a search in respect of claims All

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2,216,240 A (M-B-B)	1 at least
X	GB 2,193,561 A (ETAT FRANCAIS)	"
X	GB 2,080,926 A (DIEHL)	"
X	US 4,756,492 (M-B-B)	"
X	US 4,572,463 (ASHKENAZI)	"
X	US 3,842,741 (JACK BROS)	"

Category	Identity of document and relevant passages	Relevant to claim(s)

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